

APPENDIX B

USGS Report:

**Pesticides Detected in Urban Streams in King County,
Washington, 1998-1999**

Lonna M. Frans and Sandra S. Embrey, 2000

Pesticides detected in urban streams in King County, Washington, 1998-99

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Samples to be analyzed for pesticides and pesticide transformation products were collected at 13 urban streams in King and Snohomish Counties in 1998 (Voss and Embrey, 2000), of which Lyon Creek, Lewis Creek, Juanita Creek, and Rock Creek were again sampled during 1999. Between one and three samples were collected from the streams during early spring storms in 1998. In 1998, samples for each stream were taken on a single day as the storm progressed. Conversely, only one sample was taken per event in 1999, but during four separate events. The 1998 data for Lyon Creek, Lewis Creek, Juanita Creek, and Rock Creek are summarized here as a comparison with what was detected in samples taken in 1999. Further information regarding the 1998 samples can be found in Voss and Embrey (2000).

Sample Collection and Processing for Pesticides

Discharge-weighted water samples were collected using the U.S. DH-81 sampler as described by Edwards and Glysson (1988) and Shelton (1994). The sampler holds a 1-liter or 3-liter Teflon sample bottle, and all parts of the sampler coming into contact with sample water are constructed of Teflon. A sample representative of the flow in the stream cross section was obtained by mixing depth-integrated samples collected at equally spaced verticals across the stream in a glass carboy.

The composite sample in the glass carboy was then split into individual samples for analysis at the U.S. Geological Survey National Water Quality Laboratory (NWQL) in Denver, Colo., and the Washington State Department of Ecology Manchester Environmental Laboratory, in Manchester, Wash., using a Teflon cone splitter (Shelton, 1994). All equipment used to collect and process samples was cleaned with a 0.2-percent non-phosphate detergent, rinsed with de-ionized water, rinsed with pesticide-grade methanol, air-dried, wrapped in aluminum foil, and stored in a dust-free environment prior to sample collection (Shelton, 1994). All bottles used to collect stream water, as well as the cone splitter, were rinsed thoroughly with native water before collection and processing began.

Samples to be analyzed by the USGS were filtered through a 0.7-micrometer (μm) pore size, baked glass-fiber filter, and known quantities of surrogate compounds were added to the filtrate, and passed through a solid-phase extraction (SPE) cartridge to extract pesticide compounds. The SPE cartridge is packed with porous silica coated with a carbon-18 organic phase. After extraction, the SPE cartridges were stored in amber pesticide-free vials at less than 4 degrees Celsius and shipped to the NWQL. The equipment required and the procedures used to collect, process, and extract the sample using the SPE method are described in Shelton (1994) and Sandstrom and others (1992).

Samples analyzed by the Manchester Laboratory were collected from the cone splitter in glass bottles, but were not filtered. They were stored on ice during transport to the laboratory.

Laboratory Procedures

The 1999 samples were analyzed for a total of 153 pesticides and pesticide transformation products (hereafter referred to as pesticides) using two laboratories. At the NWQL, pesticides retained on the SPE cartridges were eluted with a hexane-isopropanol mixture and analyzed for 47 pesticides using gas chromatography/mass spectrometry (GC/MS) with selected ion monitoring (Zaugg and others, 1995) (table 1). At the Manchester Laboratory, pesticides present in the whole-water samples were extracted using methylene chloride and analyzed for 142 pesticides (table 2) using Draft USEPA Method 8085, which uses capillary column GC analysis with an atomic emission detector (AED) and ion-trap GC/MS confirmation (Huntamer and others, 1992). The 1998 samples analyzed at the Manchester Laboratory were analyzed for a shorter list of pesticides than was used with the 1999 samples. The list of pesticides analyzed for in 1998 can be found in Voss and Embrey (2000).

Results of 1999 Quality-control Samples

Quality-control samples analyzed included one field blank to assess contamination and bias and one replicate sample to assess variability. Additionally, laboratory-matrix spike samples were analyzed to measure the recovery of targeted pesticides. Quality control procedures for the NWQL and Manchester Laboratory included the use of laboratory surrogates, internal standards, and calibration as described by Pritt and Raese (1995) and by Huntamer and others (1992), respectively. The results of the 1998 quality-control samples can be found in Voss and Embrey (2000).

No pesticides were detected in the field blank. Concentration differences in the set of replicate samples ranged from 0.0 to 4.0 percent as measured by relative percent difference for samples analyzed by the NWQL and between 0.0 and 47.8 percent for samples analyzed by the Manchester Laboratory (table 3). Although the percent differences seem high for certain compounds, it is because the concentrations themselves are very low, so even small differences in concentrations can lead to large percent differences. No modifications were made to the data set based on these results. The percent recoveries for the laboratory-matrix spike target compounds typically ranged between 60 and 130 percent with a few exceptions (tables 4 and 5), and were generally acceptable for data interpretation. In cases where a compound has a much lower recovery, such as 4-nitrophenol with a recovery of only 35 percent, the concentration of the compound is likely higher than reported because some of the compound is lost

during analysis. No modifications were made to the data set based on these results.

There was some overlap of compounds analyzed by the NWQL and Manchester Laboratory, which provided additional quality assurance (tables 6 and 7). In cases of overlapping detections, the value reported by the NWQL was used for statistical analysis and interpretation because of lower reporting levels.

Pesticides detected in stream water

A total of 26 different pesticides and pesticide transformation products were detected in water samples taken during 1998 and 1999, although slightly different pesticides were detected in each year (tables 8 and 9). Of the compounds that were analyzed for in both 1998 and 1999, bromacil and 4,4-DDE were the only pesticides detected in the 1999 samples but not in the 1998 samples. Conversely, *gamma*-HCH, napropamide, EPTC, and desethylatrazine were all detected in the 1998 storm samples but not in the 1999 samples. Neither 4,4-DDT nor 4,4-DDD was analyzed for in 1998, so a comparison between years is not possible for these compounds. For most of the pesticides, the detected concentrations were similar from year to year. For example, there does not appear to be a discernable trend in concentrations of prometon at Lyon, Lewis, or Juanita Creeks or in concentrations of diazinon at Lewis or Juanita Creeks (fig. 1). However, samples from Lyon Creek do show a decline in diazinon over time, but more data would need to be collected to determine if this trend is statistically significant.

Eighteen of the pesticides were detected in both years. Of the three urban sites, Juanita Creek had the greatest number of pesticides detected. Eighteen pesticides were detected in samples from Juanita Creek in 1998 and 22 pesticides were detected in samples in 1999, whereas 17 pesticides were detected in samples from Lyon Creek in 1998 and 18 in 1999. Thirteen pesticides were detected in samples from Lewis Creek in 1998 and 9 were detected in 1999. Only one pesticide (dicamba) was detected at the reference site Rock Creek in 1999 and none were detected in 1998.

Of the 26 pesticides detected, 15 were herbicides, 5 were insecticides, 1 was a fungicide, and 5 were pesticide transformation products. The most frequently detected herbicides were 2,4-D, dichlobenil, MCPP and prometon, which were detected in almost every sample at the three urban sites. Diazinon was the most frequently detected insecticide and was detected in samples of stream water from all three of the urban sites.

A major source for about half of the detected compounds is likely the residential use of pesticides. Ten of the pesticides detected in samples from the streams in 1999 (2,4-D, carbaryl, diazinon, dichlobenil, malathion, MCPA, MCPP, prometon, triclopyr, and trifluralin) are sold in King County home and garden stores and thus are available for residential use (Voss and Embrey, 2000). Dicamba, also detected in 1999 samples, was not listed as being sold in home and

garden stores, but actually is the third active ingredient in several fertilizer-pesticide combination products. Pentachlorophenol was also not listed as being sold in retail outlets, but it is a popular wood preservative that is commercially available. The remaining pesticides that were detected likely originate from nonresidential applications.

Distribution of pesticides between suspended sediment and water

Because samples sent to the U.S. Geological Survey National Water Quality Laboratory were filtered, it is important to know the potential effect of filtration on analytical results. The total amount of a pesticide suspended in each whole-water sample is distributed between the water phase and the suspended sediment phase. Although only the concentrations in water were measured, it is possible to estimate the concentration of a compound sorbed to the suspended sediment, assuming equilibrium between the phases. The equilibrium distribution between the phases is defined as:

$$\frac{C_{ss}}{C_w} = K_{oc} f_{oc} \times 10^{-3} \quad (1)$$

where

C_{ss} = the concentration of a compound in suspended sediment, in micrograms per gram;

C_w = the concentration of a compound in water, in micrograms per liter;

K_{oc} = the sorption partition coefficient, in milliliters per gram;

$f_{oc} = \frac{SOC}{SS}$, where *SOC* is the concentration of suspended organic carbon, in milligrams per liter, and *SS* is the concentration of suspended sediment, in milligrams per liter; and 10^{-3} = unit conversion of liters per milliliter.

Because the concentration of suspended organic carbon (SOC) was not measured as part of this study, the estimate of SOC for equation (1) was based on the relation between concentrations of SOC and the concentration of suspended sediment (SS) in Thornton Creek. Thornton Creek is a small urban basin similar in size and location to the basins in this study, and both SOC and SS data were collected there as part of the Puget Sound Basin National Water-Quality Assessment Program (Sandra Embrey, written commun., 2000). A linear relation was established between the Thornton Creek SOC and SS concentrations where

$$SOC = 0.0321 * SS + 0.475 \quad (2)$$

with a coefficient of variation (R^2) of 0.75, indicating a reasonably good fit of the regression line to the data (fig. 2). Using this relation and the concentrations of suspended sediment measured in this study (table 9), values of SOC were then estimated.

The compounds diazinon, pentachlorophenol, and 2,4-D were selected for estimation of their respective concentrations in suspended sediment because they were frequently detected and their K_{oc} values span a large range within which most of the other detected compounds fall. The K_{oc} values for pentachlorophenol,

diazinon, and 2,4-D are 53,000 milligrams per liter (mL/g), 1,520 mL/g, and 19.6 mL/g, respectively (U.S Department of Agriculture, 2000; Mercer and others, 1990). A high K_{oc} value indicates that a compound will sorb more readily to sediment than will a compound with a low K_{oc} value.

As the concentration of suspended sediment increases, the fraction of each compound that will partition to the sediment also increases (fig. 3). For example, when the suspended sediment concentration is near zero, the fraction of pentachlorophenol partitioned to the sediment is less than 0.05 (5 percent) of the total concentration and is more than 0.35 (35 percent) when the suspended sediment concentration increases to more than 300 mg/L. Any compound with a large K_{oc} value will show a marked increase, as seen with pentachlorophenol. However, even though the fraction of the pesticide sorbed to sediment varies directly with suspended sediment concentrations, the fraction of the total pesticide concentration sorbed to sediment remains small. Concentrations of both diazinon and 2,4-D partitioned to the sediment never exceed 5 percent of the total concentration even at the highest suspended sediment concentrations. Virtually the entire amount of 2,4-D and diazinon is present in the water phase; the same is true for most of the rest of the detected compounds, as they also have low K_{oc} values like 2,4-D and diazinon.

References:

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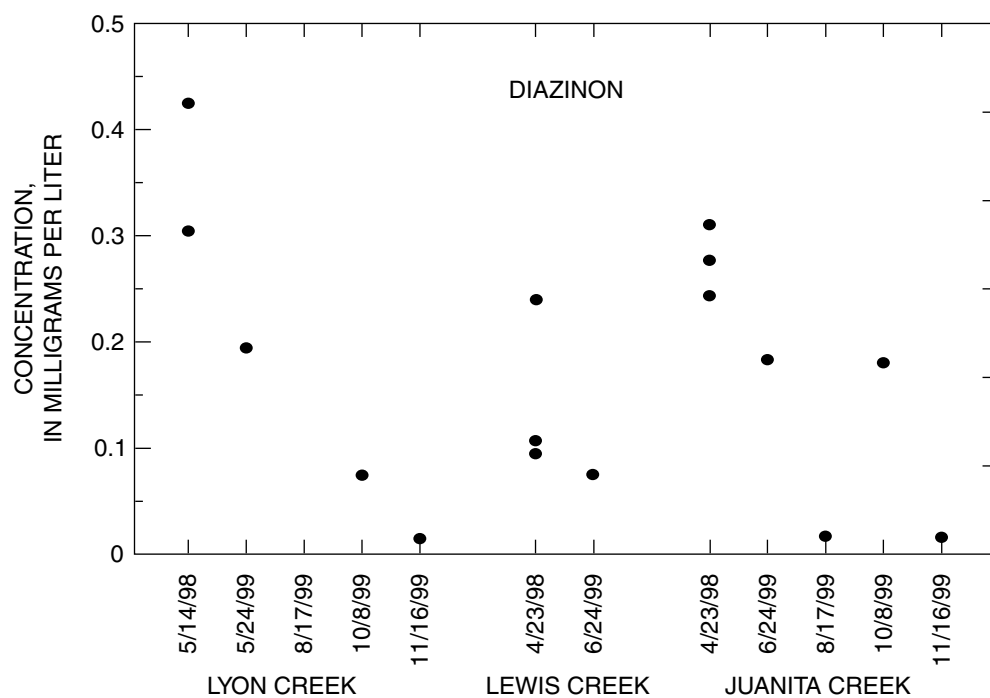
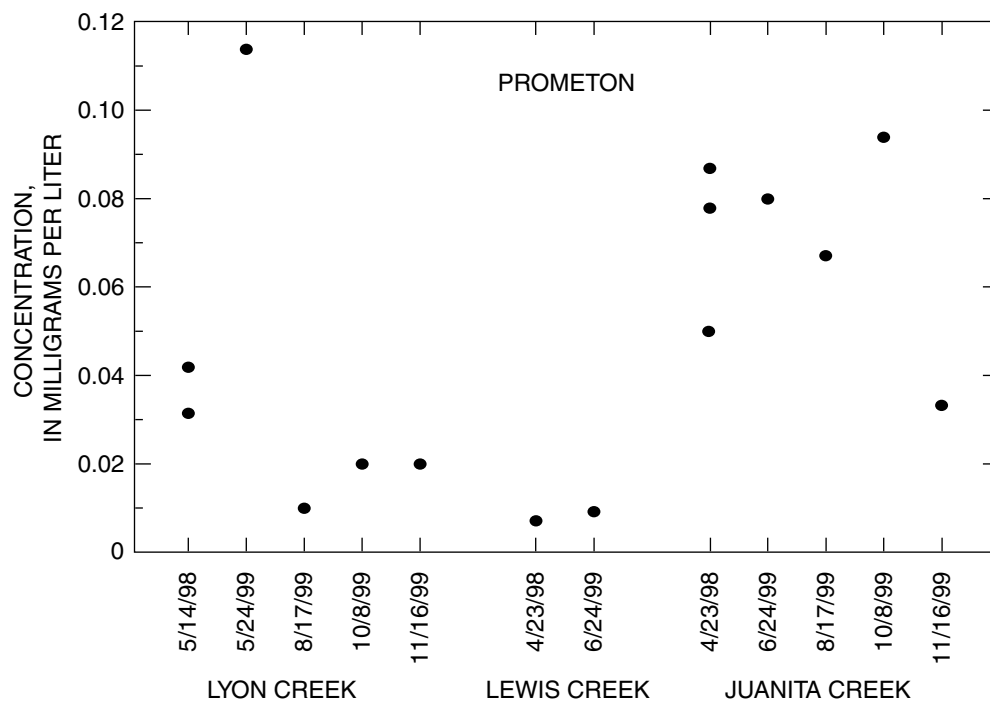


Figure 1. Concentrations of prometon and diazinon over time at Lyon Creek, Lewis Creek, and Juanita Creek.

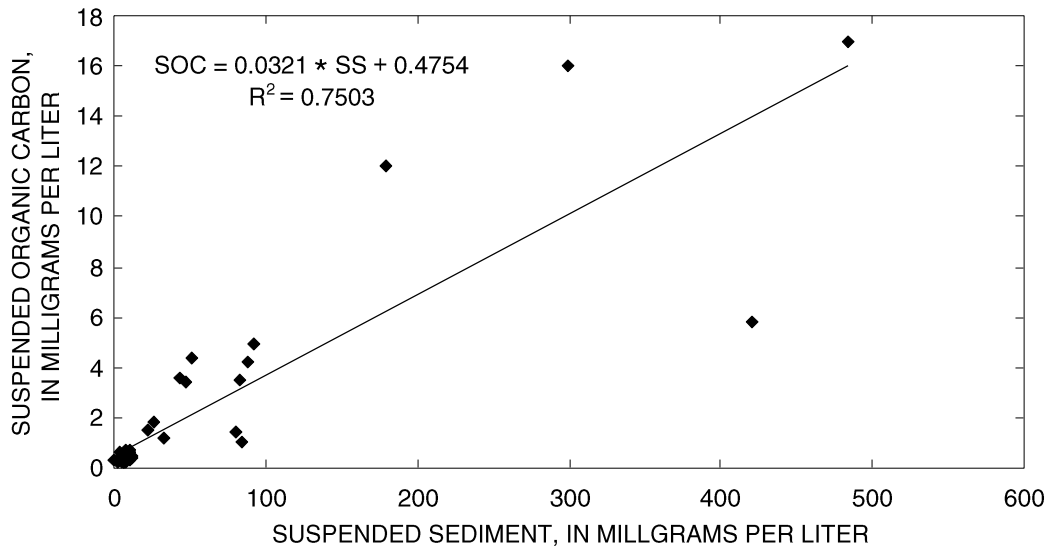


Figure 2. Relation between suspended organic carbon and suspended sediment in Thornton Creek, Washington

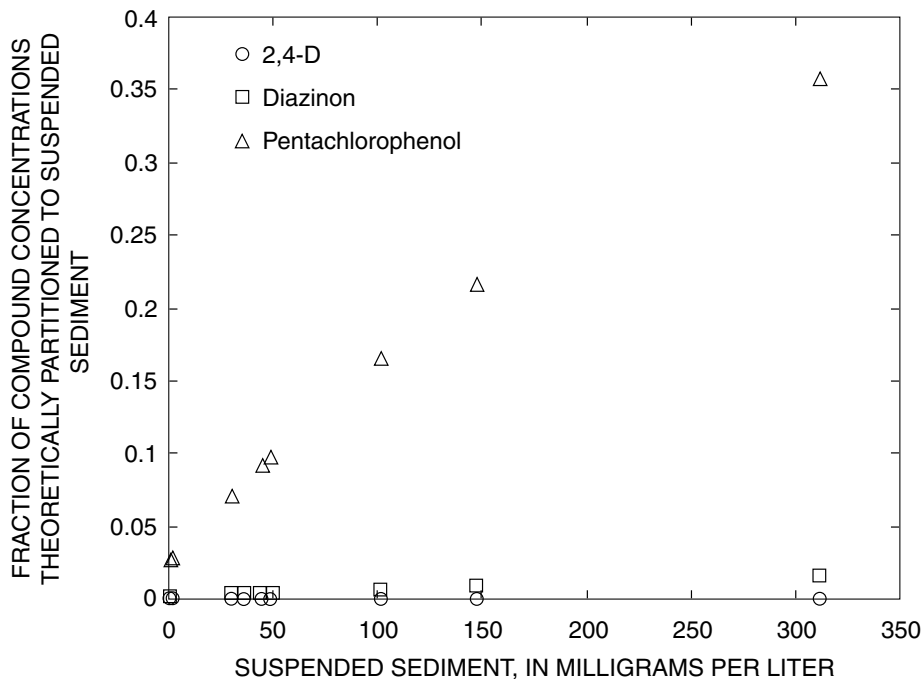


Figure 3. Theoretical relation between concentrations of suspended sediment and fractions of organic compounds sorbed to suspended sediment in Lyon Creek, Juanita Creek, and Lewis Creek. Equilibrium partitioning is assumed. The median suspended sediment concentrations were 95.7, 36.6, and 39.6 for Lyon Creek, Lewis Creek, and Juanita Creek, respectively.

Table 1. Analytes and method detection limits for pesticides analyzed at the U.S. Geological Survey National Water Quality Laboratory
[µg/L, micrograms per liter; H, herbicide; I, insecticide; T, transformation product; --, no trade or common name]

Pesticide target analyte	Trade or common name(s)	Type of pesti- cide	Chemical Abstracts Service registry number	Method detection limit (µg/L)
2,6-Diethylanaline	--	T	579-66-8	0.003
4,4-DDE	--	T	72-55-9	0.006
Acetochlor	Acenit, Sacenid	H	34256-82-1	0.002
Alachlor	Lasso	H	15972-60-8	0.002
Atrazine	AAtrex	H	1912-24-9	0.001
Azinphos-methyl ¹	Guthion	I	86-50-0	0.001
Benfluralin	Balan, Benefin	H	1861-40-1	0.002
Butylate	Sutan +, Genate Plus	H	2008-41-5	0.002
Carbaryl ¹	Sevin, Savit	I	63-25-2	0.003
Carbofuran ¹	Furadan	I	1563-66-2	0.003
Chlorpyrifos	Lorsban	I	2921-88-2	0.004
Cyanazine	Bladex	H	21725-46-2	0.004
DCPA	Dacthal	H	1861-32-1	0.002
Desethylatrazine ¹	--	T	6190-65-4	0.002
Diazinon	several	I	333-41-5	0.002
Dieldrin	Panoram D-31	I	60-57-1	0.001
Disulfoton	Di-Syston	I	298-04-4	0.017
EPTC	Eptam, Eradicane	H	759-94-4	0.002
Ethalfuralin	Sonalan, Curbit EC	H	55283-68-6	0.004
Ethoprop	Mocap	I	13194-48-4	0.003
Fonofos	Dyfonate	I	944-22-9	0.003
<i>alpha</i> -HCH	--	I	319-84-6	0.002
<i>gamma</i> -HCH	Lindane	I	58-89-9	0.004
Linuron	Lorox, Linex	H	330-55-2	0.002
Malathion	several	I	121-75-5	0.005
Methyl parathion	Pennacap-M	I	298-00-0	0.006
Metolachlor	Dual, Pennant	H	51218-45-2	0.002
Metribuzin	Lexone, Sencor	H	21087-64-9	0.004
Molinate	Ordram	H	2212-67-1	0.004
Napropamide	Devrinol	H	15299-99-7	0.003
Parathion	several	I	56-38-2	0.004
Pebulate	Tillam	H	1114-71-2	0.004
Pendimethalin	Prowl, Stomp	H	40487-42-1	0.004
<i>cis</i> -Permethrin	Ambush, Pounce	I	57608-04-5	0.005
Phorate	Thimet, Rampart	I	298-02-2	0.002
Prometon	Pramitol	H	1610-18-0	0.018
Pronamide	Kerb	H	23950-58-5	0.003
Propachlor	Ramrod	H	1918-16-7	0.007
Propanil	Stampede	H	709-98-8	0.004
Propargite	Comite, Omite	I	2312-35-8	0.013

Table 1. CONTINUED - Analytes and method detection limits for pesticides analyzed at the U.S. Geological Survey National Water Quality Laboratory

Pesticide target analyte	Trade or common name(s)	Type of pesticide	Chemical Abstracts Service registry number	Method detection limit (µg/L)
Simazine	Aquazine, Princep	H	122-34-9	0.005
Tebuthiuron	Spike	H	34014-18-1	0.01
Terbacil ¹	Sinbar	H	5902-51-2	0.007
Terbufos	Counter	I	13071-79-9	0.013
Thiobencarb	Bolero	H	28249-77-6	0.002
Triallate	Far-Go	H	2303-17-5	0.001
Trifluralin	Treflan, Trilin	H	1582-09-8	0.002

¹ Concentrations for these pesticides are qualitatively identified and reported with an E code (estimated value). E codes are used to signify estimated values for all detections that are below the method detection limit, above the highest calibration standard, or otherwise less reliable than average because of sample-specific or compound-specific considerations. All E-coded data are considered to be reliable detections, but with greater than average uncertainty in quantification.

Table 2. Analytes and quantitation limits for pesticides analyzed at the Washington State Department of Ecology Manchester Environmental Laboratory
[µg/L, micrograms per liter; H, herbicide; I, insecticide; T, transformation product; F, fungicide; --, no trade or common name]

Pesticide target analyte	Trade or common name(s)	Type of pesticide	Chemical Abstracts Service registry number	Quantitation limit ¹ (µg/L)
2,3,4,5-Tetrachlorophenol	Dowicide 6	F	4901-51-3	0.023
2,3,4,6-Tetrachlorophenol	Dowicide 6	F	58-90-2	0.023
2,4,5-T	--	H	93-76-5	0.033
2,4,5-TB	--	H	93-80-1	0.038
2,4,5-TP	Silvex	H	93-72-1	0.033
2,4,5-Trichlorophenol	Dowicide 2	F	95-95-4	0.025
2,4,6-Trichlorophenol	Dowicide 2S	F	88-06-2	0.025
2,4-D	Weed-B-Gon, Weedone	H	94-75-7	0.042
2,4-DB	Venceweed, Butoxone	H	94-82-6	0.050
2,4'-DDD	TDE	I	53-19-0	0.035
2,4'-DDE	--	T	3424-82-6	0.035
2,4'-DDT	DDT	I	789-02-6	0.035
2,6-Dichlorobenzamide	--	T	2008-58-4	0.081
3,5-Dichlorobenzoic Acid	--	H	51-36-5	0.042
4,4'-DDD	TDE	I	72-54-8	0.035
4,4'-DDE	--	T	72-55-9	0.035
4,4'-DDT	DDT	I	50-29-3	0.035
4-Nitrophenol	--	T	100-02-7	0.073
Acifluorfen	Blazer	H	62476-59-9	0.17
Alachlor	Lasso	H	15972-60-8	0.26
Aldrin	Aldrex	I	309-00-2	0.035
Ametryn	Evik, Gesapax	H	834-12-8	0.071
Atraton	Gesatamin	H	1610-17-9	0.21
Atrazine	AAtrex	H	1912-24-9	0.071
Azinphos-methyl	Guthion	I	86-50-0	0.12
Azinphos ethyl	Azinos, Gusathion A	I	2652-71-9	0.12
Benfluralin	Benefin, Balan	H	1861-40-1	0.11
Bentazon	Basagran	H	25057-89-0	0.063
Bromacil	Hyvar, Urox B	H	314-40-9	0.28
Bromoxynil	Buctril, Brominal	H	1689-84-5	0.042
Butachlor	Lambast, Butanox	H	23184-66-9	0.25
Butylate	Sutan +, Genate Plus	H	2008-41-5	0.14
Captafol	Difolatan, Haipen	F	2425-06-1	0.21
Captan	Orthocide	F	133-06-2	0.14
Carbophenothion	Trithion	I	786-19-6	0.80
Carboxin	Oxatin, Viatavax	F	5234-68-4	0.78
cis-Chlordane	Belt	I	5103-71-9	0.035
trans-Chlordane	Belt	I	5103-74-2	0.035
alpha-Chlordene	--	I	56534-02-2	0.043
gamma-Chlordene	--	I	56534-04-G	0.035
Chlorothalonil	Daconil, Bravo	F	1897-45-6	0.17

Table 2. CONTINUED - Analytes and quantitation limits for pesticides analyzed at the Washington State Department of Ecology Manchester Environmental Laboratory

Pesticide target analyte	Trade or common name(s)	Type of pesti- cide	Chemical Abstracts Service registry number	Quantitation limit ¹ (µg/L)
Chlorpropham	Taterpex, Sprout Nip	H	101-21-3	0.28
Chlorpyrifos	Lorsban	I	2921-88-2	0.055
Coumaphos	Agridip	I	56-72-4	0.090
Cyanazine	Bladex	H	21725-46-2	0.11
Cycloate	Sabet	H	1134-23-2	0.14
DCPA	Dacthal	H	1861-32-1	0.033
DDMU	--	T	1022-22-6	0.035
Demeton-O	Systox	I	298-03-3	0.055
Demeton-S	Systox	I	126-75-0	0.060
Di-allate	Avadex	H	2303-16-4	0.27
Diazinon	several	I	333-41-5	0.06
Dicamba	Banvel	H	1918-00-9	0.042
Dichlobenil	Barrier, Casoron	H	1194-65-6	0.16
Dichlorprop	2,4-DP, Seritox 50	H	120-36-5	0.046
Dichlorvos	DDVP	I	62-73-7	0.060
Dicofol	Kelthane	I	115-32-2	0.17
Diclofop-Methyl	Hoelon	H	51338-27-3	0.063
Dieldrin	Panoram D-31	I	60-57-1	0.035
Dimethoate	Cygon 400, Trounce	I	60-51-5	0.060
Dinoseb	DNBP, Dinitro	H	88-85-7	0.063
Dioxathion	--	I	78-34-2	0.12
Diphenamid	Dymid	H	957-51-7	0.21
Disulfoton	Di-Syston	I	298-04-4	0.045
Diuron	Karmex, Direx	H	330-54-1	0.48
Endosulfan I	several	I	959-98-8	0.035
Endosulfan II	several	I	33213-65-9	0.035
Endosulfan Sulfate	--	T	1031-07-8	0.035
Endrin	Hexadrin	I	72-20-8	0.035
Endrin Aldehyde	--	T	7421-93-4	0.035
Endrin Ketone	--	T	53494-70-5	0.035
EPN	--	I	2104-64-5	0.075
EPTC	Eptam, Eradicane	H	759-94-4	0.14
Ethalfuralin	Sonalan, Curbit EC	H	55283-68-6	0.11
Ethion	Ethiosul	I	563-12-2	0.055
Ethoprop	Mocap	I	13194-48-4	0.060
Fenamiphos	Nemacur	I	22224-92-6	0.12
Fenarimol	Rubigan	F	60168-88-9	0.21
Fenitrothion	Fenitox, Rothion	I	122-14-5	0.055
Fensulfothion	Dasanit	I	115-90-2	0.075
Fenthion	Baytex	I	55-38-9	0.055
Fonofos	Dyfonate	I	944-22-9	0.045
<i>alpha</i> -HCH	--	T	319-84-6	0.035
<i>beta</i> -HCH	--	I	319-85-7	0.035

Table 2. CONTINUED - Analytes and quantitation limits for pesticides analyzed at the Washington State Department of Ecology Manchester Environmental Laboratory

Pesticide target analyte	Trade or common name(s)	Type of pesti- cide	Chemical Abstracts Service registry number	Quantitation limit ¹ (µg/L)
<i>delta</i> -HCH	--	I	319-86-8	0.035
<i>gamma</i> -HCH	Lindane	I	58-89-9	0.035
Heptachlor	Fennotox	I	76-44-8	0.035
Heptachlor Epoxide	--	T	1024-57-3	0.035
Hexazinone	Velpar	H	51235-04-2	0.11
Ioxynil	Certrol H	H	1689-83-4	0.042
Malathion	several	I	121-75-5	0.060
MCPA	Metaxon, Kilsem	H	94-74-6	0.083
MCPP	Mecoprop	H	93-65-2	0.083
Merphos (1 & 2)	Folex	H	150-50-5	0.12
Metalaxyl	Apron	F	57837-19-1	0.48
Methoxychlor	Marlate	I	72-43-5	0.035
Methyl Chlorpyrifos	Reldan	I	5598-13-0	0.050
Methyl Paraoxon	--	T	950-35-6	0.15
Methyl Parathion	Pennac-M	I	298-00-0	0.055
Metolachlor	Dual, Pennant	H	51218-45-2	0.28
Metribuzin	Lexone, Sencor	H	21087-64-9	0.071
Mevinphos	Phosdrin	I	7786-34-7	0.075
MGK264	--	I	113-48-4	0.50
Mirex	--	I	2385-85-5	0.035
Molinate	Ordram	H	2212-67-1	0.14
Napropamide	Devrinol	H	15299-99-7	0.21
<i>cis</i> -Nonachlor	--	I	5103-73-1	0.035
<i>trans</i> -Nonachlor	--	I	39765-80-5	0.035
Norflurazon	Evital, Solicam	H	27314-13-2	0.14
Oxychlordan	--	T	27304-13-8	0.035
Oxyfluorfen	Goal	H	42874-03-3	0.28
Parathion	several	I	56-38-2	0.06
Pebulate	Tillam	H	1114-71-2	0.14
Pendimethalin	Prowl, Stomp	H	40487-42-1	0.11
Pentachlorophenol	PCP, Penta	F	87-86-5	0.021
Phorate	Thimet, Rampart	I	298-02-2	0.055
Phosmet	Imidan	I	732-11-6	0.080
Phosphamidan	--	I	297-99-4	0.18
Picloram	Tordon	H	1918-02-1	0.042
Profluralin	Tolban	H	26399-36-0	0.17
Prometon	Pramitol	H	1610-18-0	0.071
Prometryn	Caparol, Gesagard	H	7287-19-6	0.071
Pronamide	Kerb	H	23950-58-5	0.28
Propachlor	Ramrod	H	1918-16-7	0.17
Propazine	Prozinex	H	139-40-2	0.071
Propetamphos	Safrotin	I	31218-83-4	0.15
Ronnel	Fenclophos	I	299-84-3	0.055

Table 2. CONTINUED - Analytes and quantitation limits for pesticides analyzed at the Washington State Department of Ecology Manchester Environmental Laboratory

Pesticide target analyte	Trade or common name(s)	Type of pesti- cide	Chemical Abstracts Service registry number	Quantitation limit ¹ (µg/L)
Simazine	Aquazine, Princep	H	122-34-9	0.072
Sulfotep	Bladafum	I	3689-24-5	0.045
Sulprofos	Bolstar	I	35400-43-2	0.055
Tebuthiuron	Spike	H	34014-18-1	0.11
Temephos	Abate	I	3383-96-8	0.70
Terbacil	Sinbar	H	5902-51-2	0.21
Terbutryn	Igran	H	886-50-0	0.071
Tetrachlorvinphos	Gardona	I	961-11-5	0.15
Toxaphene	Camphechlor	I	8001-35-2	0.85
Triadimefon	Bayleton	F	43121-43-3	0.18
Triallate	Far-Go	H	2303-17-5	0.18
Tribufos	DEF	H	78-48-8	0.11
Trichlopyr	Garlon, Grazon	H	55335-06-3	0.035
Trifluralin	Treflan, Trilin	H	1582-09-8	0.11
Vernolate	Vernam, Surpass	H	1929-77-7	0.14

¹Quantitation limits are approximate and are often different for each sample; these values are representative of a typical sample

Table 3. Concentrations and precision data for replicate samples with detections
[µg/L, micrograms per liter; J, estimated]

Pesticide	Concentration in replicates (µg/L)	Relative percent difference ¹
<u>U.S. Geological Survey National Water Quality Laboratory analyses</u>		
Simazine	1.03 1.00	2.9
Prometon	0.114 0.113	0.88
Diazinon	0.194 0.202	4.0
Carbaryl	J0.121 J0.118	2.5
<u>Washington Department of Ecology Manchester Environmental Laboratory analyses</u>		
2,4-D	0.34 0.36	5.7
4-Nitrophenol	J0.1 J0.065	42.4
2,6-Dichlorobenzamide	J0.086 J0.14	47.8
Diazinon	0.16 0.11	37.0
Dicamba	J0.027 J0.02	29.8
Dichlobenil	0.24 0.18	28.6
Dichlorprop	J0.032 J0.032	0.0
MCPP	0.57 0.54	5.4
Pentachlorophenol	0.1 0.1	0.0
Simazine	0.25 0.17	38.1
Trichlopyr	0.18 0.18	0.0

¹Relative percent difference is calculated as the difference between the two concentrations divided by the mean

Table 4. Summary of percent mean recoveries from laboratory-reagent-spike pesticide analyses for 1999 for the USGS National Water Quality Laboratory

Pesticide target analyte	Mean recovery (percent)	Standard deviation (percent)
2,6-Diethylaniline	86	10.6
4,4-DDE	55	8.4
Acetochlor	99	12.3
Alachlor	102	13.0
Atrazine	97	10.1
Azinphos-methyl	86	33.6
Benfluralin	64	13.0
Butylate	88	9.8
Carbaryl	125	59.8
Carbofuran	133	57.5
Chlorpyrifos	90	9.8
Cyanazine	100	12.9
DCPA	97	11.1
Desethylatrazine	61	17.1
Diazinon	93	10.6
Dieldrin	86	13.1
Disulfoton	76	13.5
EPTC	91	9.2
Ethalfuralin	77	14.9
Ethoprop	86	12.8
Fonofos	92	12.1
<i>alpha</i> -HCH	94	12.1
<i>gamma</i> -HCH	96	12.4
Linuron	114	45.7
Malathion	92	13.6
Metolachlor	97	11.9
Metribuzin	91	13.6
Molinate	93	9.2
Napropamide	89	14.2
Parathion	92	32.3
Parathion-methyl	95	26.7
Pebulate	90	8.8
Pendimethalin	71	16.6
<i>cis</i> -Permethrin ¹	38	9.8
Phorate	81	13.5
Prometon	95	12.4
Pronamide	94	10.9
Propachlor	101	12.4
Propanil	106	15.3
Propargite	74	21.8
Simazine	108	14.3
Tebuthiuron	119	20.8
Terbacil	113	46.2
Terbufos	82	10.1
Thiobencarb	97	10.8
Triallate	90	11.6
Trifluralin	68	13.7

¹Spike solution contains both *cis*- and *trans*- permethrin, but only the *cis* isomer is reported. *Cis*-permethrin is commonly recovered at about 40 percent in laboratory spike samples.

Table 5. Summary of percent mean recoveries from laboratory-reagent-spike pesticide analyses for 1999 for the Washington State Department of Ecology Manchester Environmental Laboratory

Pesticide target analyte	Mean recovery (percent)	Standard deviation (percent)
2,3,4,5-Tetrachlorophenol	118	6.1
2,3,4,6-Tetrachlorophenol	108	6.7
2,4,5-T	96	10.8
2,4,5-TB	99	5.9
2,4,5-TP	106	14.6
2,4,5-Trichlorophenol	129	28.7
2,4,6-Trichlorophenol	101	6.8
2,4-D	97	24.7
2,4-DB	110	5.2
3,5-Dichlorobenzoic Acid	93	6.2
4,4'-DDD	88	2.1
4,4'-DDE	86	2.1
4,4'-DDT	94	0.7
4-Nitrophenol	35	8.2
Acifluorfen	89	17.2
Alachlor	83	2.5
Aldrin	53	12.7
Atrazine	80	3.7
Azinphos-methyl	102	34.6
Bentazon	100	2.2
<i>alpha</i> -HCH	84	3.5
<i>beta</i> -HCH	89	1.4
<i>delta</i> -HCH	89	0.0
<i>gamma</i> -HCH	100	9.2
Bromacil	100	19.5
Bromoxynil	108	4.2
<i>trans</i> -Chlordane	86	3.5
Coumaphos	107	35.0
DCPA	61	40.3
Diazinon	110	12.8
Dicamba	64	9.7
Dichlobenil	78	11.9
Dichlorprop	106	8.3
Diclofop-methyl	92	7.7
Dieldrin	86	2.1
Dimethoate	101	6.1
Dinoseb	91	30.0
Diphenamid	83	2.1
Endosulfan I	86	2.8
Endosulfan II	88	1.4
Endosulfan Sulfate	84	4.2
Endrin	89	2.8
Endrin Aldehyde	84	5.0
Endrin Ketone	88	0.7
Ethalfuralin	76	5.3
Ethoprop	98	12.3
Fensulfothion	122	7.2
Fenthion	104	25.6
Heptachlor	56	8.5

Table 5. CONTINUED Summary of percent mean recoveries from laboratory-reagent-spike pesticide analyses for 1999 for the Washington State Department of Ecology Manchester Environmental Laboratory

Pesticide target analyte	Mean recovery (percent)	Standard deviation (percent)
Ioxynil	108	4.6
MCPA	93	7.0
MCPP	111	13.4
Methoxychlor	86	2.8
Methyl Parathion	96	18.2
Metolachlor	87	3.2
Metribuzin	78	1.9
Napropamide	82	2.2
Norflurazon	96	4.2
Oxyfluorfen	80	5.6
Parathion	98	19.8
Pendimethalin	93	6.2
Pentachlorophenol	128	7.9
Phorate	98	14.7
Phosmet	100	25.9
Picloram	22	3.6
Prometryn	86	1.9
Pronamide	84	2.4
Propachlor	86	2.5
Ronnel	96	21.8
Simazine	83	2.6
Sulprofos	94	25.0
Tebuthiuron	104	19.2
Terbacil	98	12.0
Trichlopyr	120	22.2
Trifluralin	86	3.7

Table 6. Concentrations of all overlapping pesticides and pesticide transformation products detected by either the U.S. Geological Survey National Water Quality Laboratory or the Washington State Department of Ecology Manchester Environmental Laboratory in 1998
 [USGS, U.S. Geological Survey laboratory values; WDOE, Washington State Department of Ecology laboratory values; J, Estimated value; <, less than. All values are in micrograms per liter]

Site name	Date	Sample	Atrazine		EPTC		Metolachlor		Napropamide	
			USGS	WDOE	USGS	WDOE	USGS	WDOE	USGS	WDOE
Lyon Creek	5/14/98	1	0.019	<0.33	<0.002	<0.041	<0.002	<0.081	0.02	<0.061
		2	0.021	<0.32	<0.002	<0.04	<0.002	<0.08	0.01	<0.06
Lewis Creek	4/23/98	1	<0.001	<0.02	0.005	<0.039	<0.002	<0.079	<0.003	<0.059
		2	J0.002	<0.021	<0.002	<0.042	<0.002	<0.083	<0.003	<0.063
		3	J0.002	<0.021	<0.002	<0.042	<0.002	<0.083	<0.003	<0.063
Juanita Creek	4/23/98	1	<0.001	<0.02	<0.002	<0.079	<0.002	<0.079	<0.003	<0.06
		2	0.004	<0.02	<0.01	<0.041	<0.002	<0.082	<0.003	<0.061
		3	<0.001	<0.02	0.009	<0.04	0.004	<0.081	<0.003	<0.06

Site name	Date	Sample	Prometon		Simazine		Trifluralin	
			USGS	WDOE	USGS	WDOE	USGS	WDOE
Lyon Creek	5/14/98	1	0.031	<0.33	4.73	3.3	<0.002	<0.052
		2	0.042	<0.32	4.99	3.3	<0.002	<0.03
Lewis Creek	4/23/98	1	<0.018	<0.02	<0.005	<0.02	<0.002	<0.03
		2	J0.007	<0.021	J0.002	<0.021	<0.002	<0.031
		3	J0.007	<0.021	<0.005	<0.021	<0.002	<0.031
Juanita Creek	4/23/98	1	0.05	<0.02	<0.005	<0.02	J0.002	<0.079
		2	0.087	<0.02	0.014	<0.02	J0.003	<0.031
		3	0.078	<0.02	0.026	<0.02	J0.003	<0.081

Table 7. Concentrations of all overlapping pesticides and pesticide transformation products detected by either the U.S. Geological Survey National Water Quality Laboratory or the Washington State Department of Ecology Manchester Environmental Laboratory in 1999

[USGS, U.S. Geological Survey laboratory values; WDOE, Washington State Department of Ecology laboratory values; J, Estimated value; <, less than. All values are in micrograms per liter]

Site name	Date	4,4-DDE		Atrazine		Diazinon		Malathion	
		USGS	WDOE	USGS	WDOE	USGS	WDOE	USGS	WDOE
Lyon Creek	6/24/99	<0.006	<0.011	<0.001	<0.02	0.194	0.16	<0.03	<0.004
	8/17/99	<0.006	<0.011	0.004	<0.02	<0.002	<0.016	<0.005	<0.016
	10/8/99	<0.006	<0.012	<0.001	<0.067	0.073	0.045	0.017	<0.017
	11/16/99	<0.006	J0.0021	<0.001	<0.02	0.014	J0.014	<0.005	<0.016
Lewis Creek	6/24/99	<0.006	<0.011	<0.001	<0.02	0.073	J0.049	<0.005	<0.002
Juanita Creek	6/24/99	<0.006	<0.011	<0.001	<0.02	0.182	0.14	<0.01	<0.004
	8/17/99	<0.006	<0.011	0.005	<0.02	0.014	J0.021	<0.005	<0.016
	10/8/99	<0.006	<0.011	<0.001	<0.02	0.179	0.12	0.01	<0.016
	11/16/99	<0.006	J0.0027	<0.001	<0.02	0.013	J0.015	<0.005	<0.016
Site name	Date	Metolachlor		Prometon		Simazine		Trifluralin	
		USGS	WDOE	USGS	WDOE	USGS	WDOE	USGS	WDOE
Lyon Creek	6/24/99	<0.002	<0.08	0.114	<0.02	1.03	0.25	<0.002	<0.03
	8/17/99	<0.002	<0.08	J0.01	<0.02	0.416	0.28	<0.002	<0.03
	10/8/99	<0.002	<0.083	0.02	<0.021	0.223	<0.02	<0.002	<0.031
	11/16/99	<0.002	<0.081	0.019	<0.02	<0.005	<0.02	<0.002	<0.03
Lewis Creek	6/24/99	<0.002	<0.081	J0.009	<0.02	<0.005	<0.02	<0.002	<0.03
Juanita Creek	6/24/99	0.142	<0.079	0.08	J0.017	<0.005	<0.02	0.006	<0.03
	8/17/99	<0.002	<0.079	0.067	J0.057	J0.004	<0.02	<0.002	<0.03
	10/8/99	<0.002	<0.082	0.094	<				
	11/16/99	<0.002	<0.081	0.033	<				

